



NASA's Space Launch System: Additive Manufacturing

Chris Crumbly

Manager, Spacecraft/Payload Integration and Evolution
Space Launch System (SLS) Program

September 2014

Space Launch System





The Journey to Mars

EARTH RELIANT

MISSION: 6 TO 12 MONTHS
RETURN TO EARTH: HOURS



Mastering fundamentals
aboard the International
Space Station

U.S. companies
provide access to
low-Earth orbit

PROVING GROUND

MISSION: 1 TO 12 MONTHS
RETURN TO EARTH: DAYS



Expanding capabilities by
visiting an asteroid redirected
to a lunar distant retrograde orbit

The next step: traveling beyond low-Earth
orbit with the Space Launch System
rocket and Orion spacecraft



MARS READY

MISSION: 2 TO 3 YEARS
RETURN TO EARTH: MONTHS




Developing planetary independence
by exploring Mars, its moons and
other deep space destinations

Selective Laser Melting Road to Flight




Component Development


✓ Built and hot-fire tested J-2X gas generator discharge duct



✓ J-2X fuel turbine exhaust duct maintenance port plug is being built for engine hot-fire testing



✓ Successfully built RS-25 internally tied bistra



Will build and water flow test RS-25 POGO Z-baffle.




Plans in work to green run and certify SLM POGO Z-baffle for use on RS-25

Material and Process Development

✓ Created draft SLM Engineering and Quality Guidelines document

✓ Developing inspection techniques

✓ Procurement of SLM machine for MSFC Materials Lab

✓ Mechanical testing of material samples, developing materials verification matrix


✓ Working with Army and Air Force on material development

Additional MSFC Activities

✓ Participation in 3 separate proposals for Air Force Broad Agency announcement, pilot Additive Mfg Innovation Institute

✓ Engineering Development:

- Unique tooling fabrication
- injector elements and various other components for MSFC component test bed
- Turbopump components
- Small thruster development



Build flight rationale

Fly SLM components in 2017

✓ Activity Completed
✓ Activity in work

Selective Laser Melting Examples

